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Accessibility of Saudi Delivery Applications for Visually Impaired Users

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Abstract

This study explores accessibility issues related to registration, payment forms, and food menus of food delivery applications in Saudi Arabia for visually impaired users. It evaluates them based on the last version of Web Accessibility Guidelines WCAG 2.2 provided by The World Wide Web Consortium W3C, which is a document that explains how to make web content more accessible to people with disabilities. The results show that delivery applications in Saudi Arabia are made with many accessibility issues that may be solved by following the recommendations of this study.

Keywords: *Accessibility, Visually impaired users, Usability, Saudi, Delivery applications*

ملخص

تستكشف هذه الدراسة مشاكل إمكانية الوصول المتعلقة بنماذج التسجيل واستمارات الدفع، وقوائم الطعام في تطبيقات توصيل الطعام في المملكة العربية السعودية بالنسبة للمستخدمين الذين يعانون من إعاقة بصرية. حيث تقوم الدراسة بتقييم تطبيقات توصيل الطعام استنادًا إلى الإصدار الأخير من إرشادات الوصول إلى الويب WCAG 2.2 المقدمة من اتحاد شبكة الويب العالمية W3C ، وهي وثيقة تشرح كيفية جعل محتوى الويب أكثر سهولة في الوصول للأشخاص ذوي الإعاقة. تظهر النتائج أن طلبات التوصيل في المملكة العربية السعودية تحتوي على العديد من مشكلات الوصول التي يمكن حلها باتباع توصيات هذه الدراسة.

الكلمات المفتاحية: إمكانية الوصول، المعاقين بصرياً، سهولة الاستخدام ، السعودية ، تطبيقات التوصيل

1. Introduction

The need for the internet in every aspect of life is an indisputable fact. It is a vital source of information and services for education, economics, government, entertainment, and other content that is provided by websites and applications. According to a recent statistic of the Saudi Communications and Information Technology Commission, the number of Internet users in Saudi Arabia reached 33.85 million users in 2021. Additionally, are more than 30 million smartphone users in Saudi Arabia (Smartphone Users in Saudi Arabia 2018-2023, n.d.). They use different mobile applications for many purposes.

Nowadays, web content accessibility is considered very important. Designers and developers should not think that all the users have the same ability to access a web page (Charski, 2015). Accessibility aims to provide everyone with fair access to web content. However, people with disabilities may face difficulty using the internet, especially people who are blind or have any visual impairment, whereas internet websites or applications are primarily a visual environment. Based on the General Authority for Statistics, the number of visually impaired people in Saudi Arabia reached nearly 375,000 with different types and degrees of impairments (Disability Survey, 2017). In light of this fact, web content developers must make more effort to design easy and accessible content to enable them to use the content and accomplish the tasks without needing other sighted people. Therefore, this paper looks at the current accessibility state for a sample of food delivery applications in Saudi Arabia and explores the accessibility issues related to registration or payment forms and food menus. The paper will also evaluate a sample of applications based on the last version of Web Accessibility Guidelines WCAG 2.2 provided by the W3C, which is a document that explains how to make web content more accessible to people with disabilities.

1.1Mobile accessibility at a glance

Web Content Accessibility Guidelines (WCAG) area set of guidelines proposed by the World Wide Web Consortium (W3C) to make web content accessible to disabled people. WCAG has gone through several developmental versions that provide more success criteria that serve disabled people, from WCAG 1.0, which was published as a W3C Recommendation in May 1999, to WCAG 2.1 published in 2021 (W3C, 2018). These web content guidelines often relate

to non-web content also, including mobile phones (Patch et al., 2021). Guidance on Applying WCAG 2.0 to Non-Web Information and Communications Technologies (WCAG2ICT) illustrates how the Web Content Accessibility Guidelines (WCAG) 2.0 [WCAG20], as well as its principles, guidelines, and success criteria, can be applied to non-web Information and Communications Technologies ICT (Korn et al., 2013). Most success criteria from WCAG 2.0 can apply to non-web content and mobile applications with no or only minimal changes. WCAG 2.0 includes a wide range of guidelines for improving the accessibility of people with impairments of any kind and all users; it contains four main parts: principles, guidelines, success criteria, and techniques. The four principles are Perceivable, Operable, Understandable, and Robust (POUR). Under the four principles, 13 guidelines focus on different types of content to achieve accessibility. For each guideline, there are success criteria, which are at three levels: A (basic), AA (recommended), and AAA (Ideal), and set of techniques that can be used to meet the success criteria (W3C, 2018).

1.1.2 Accessibility for visually impaired mobile phone users

Visual impairment and blindness can be viewed as formidable health problems because of their increased prevalence, and visible defects are among the most common causes of disability globally (Vishnu Prasad et al., 2018). People with a visual impairment such as visual acuity, light sensitivity, contrast sensitivity, or color vision have some usable vision and can read some text when displayed optimally (Ferati et al., 2014). So, the developers of web content or mobile applications have to take into their account that not all users who use their content are completely sighted or not using any assistive technology. Managing with visual impairment in a society where most people consider their surroundings with vision is one of the most prominent challenges that visually impaired people face (Griffin-Shirley et al., 2017). Nowadays, smartphones provide accessibility tools that help visually impaired people use their phones for daily needs, such as voice commands, screen readers, and magnifiers. However, they still face challenges regarding accessibility while using their phones (Mi et al., 2014).

1.2 Overview of food delivery apps in Saudi Arabia

What was previously mentioned about the number of smartphone users in Saudi Arabia proves increasing users' demand for services provided via the Internet. One of the services is ordering food online whether it is food delivery or takeout from a restaurant after ordering via a website page or a mobile app (Khan, 2020). Due to the impact of COVID-19 in the world, including Saudi Arabia, everyone was forced not to go out; all restaurants have canceled their eat-in service, and then later; all restaurants committed to social distancing regulations and prevented getting larger gatherings of customers. For that reason, turnout for food delivery applications significantly increased during the epidemic of the novel coronavirus (Covid-19). This is confirmed by the Communications and Information Technology Commission, where its statistics refer to the increase in online delivery ordering during the (COVID-19) pandemic by 250% and 460% increase in registered delivery apps compared with the previous year. It's clear that the pandemic has positively affected the food delivery market, where the number of ordering food through applications exceeded 26 million orders. At the same time, the total value of orders exceeded 22 billion riyals during mid-2020 (In Saudi Arabia; Revenue of Orders Made Through Delivery Applications Reaches Over 2 Billion Riyals, n.d.). Even after the obstacles of the pandemic in 2020, the Online Food Ordering and Delivery Market in Saudi Arabia will continue to grow steadily; it is expected to increase at a 10.05% compound annual growth rate (CAGR) between 2021 and 2026 (Newswire, 2021). Other factors also contribute to this increase in the number of online orders. People, for example, prefer to choose an easier and faster way to get food while they are busy with work or studying. The promotions and discounts offered by the applications are another factor. They also offer a wide choice of restaurants; the customer can choose the appropriate restaurant, see the pictures of dishes, and choose the appropriate additions for him. In the payment step, he can choose the proper payment method, so it is not necessary to have Cash; he can use online payments. Some applications also allow you to order from more than one restaurant at the same time; it is natural for a person to prefer this option than to spend time and energy to move between restaurants on crowded roads (Newswire, 2021). Therefore, these applications have to ensure that they are easy to use and accessible to everyone, including people with visual impairments.

2. Review of the literature

The following section contains a literature review which discuss accessibility of mobile phones and applications with different purpose, as well as online food shopping in Saudi Arabia.

• Accessibility of mobile phones

A significant number of Android apps have been analyzed to be evaluated in (Vendome et al., n.d.). From an analysis of the apps, a set of lessons to guide further research and actions to help developers support users who require assistive features and more accessibility to be able to use the apps are provided. Researchers in (Badshah et al., 2020) confirmed the importance of considering people with disabilities and giving their needs a top priority in the development of smartphone apps. They report on 27 problems related to the useability and accessibility of apps. And for visually impaired users in particular (Sultan et al., 2015) and (Griffin-Shirley et al., 2017) addressed the problems and guidelines of mobile phones accessibility. Selecting an option from the menu, making a call, composing a message, reading a message, and searching for a contact were some problems they faced in accessing mobile applications and completing basic tasks as discussed in (Sultan et al., 2015). Thus, they recommended developing applications to be more blind-friendly to assist the blind in interacting with society. The results of a survey on the use of mobile applications for visually impaired people conducted by (Griffin-Shirley et al., 2017) offers preliminary information on app usage, with a total of 259 participants, concluded that developers of apps for visually impaired people need to enhance and test existing apps.

• Online food shopping in Saudi Arabia

Continuing urbanization, changing lifestyles, and the emerging online culture of a young and tech-savvy population led to the rapidly growing demand for online food delivery in Saudi Arabia (December et al., 2014). The findings of the study (December et al., 2014) revealed that online grocery shopping (OGS) is widely accepted in Saudi Arabia. It was also discovered that a good attitude toward OGS and regular online purchasing was essential predictors of OGS acceptability. In addition, the study indicated that the essential criteria supporting online grocery shopping are home delivery and website security. The top four online food ordering apps of Saudi Arabia are evaluated by (Khan, 2020). The study revealed that user-friendly apps

are one of the foremost influencing factors for online food ordering. It also revealed that the idea of online food ordering appeals more to technology-friendly people such as young people. On the other hand, the study of (Bigdeli et al., 2009) explored that not updating web design and sites layout as well as incomplete product lists cause problems for customer browsing and online shopping in Saudi Arabia.

- **Applying accessibility for different apps' purpose**

A sample of a variety of purposes' apps, including Banking, Economy, Security, and Tourism apps, are evaluated using an adapted version of WCAG in (Serra et al., 2015). The results show many important problems regarding the accessibility of e-government applications. After they verified that many weather apps were not developed to meet accessibility requirements to low vision or screen reader users, the authors in (Walker et al., 2017) developed a weather app with an accessible design shown in different fonts, high contrast color, and simple layout. In addition to different disabilities, children's mental models are considered in (Masood & Thigambaram, 2015), and the importance of usability in user interface design for pre-school children mobile educational apps is investigated. To that end, they proposed a user interface guideline of design elements and principles for designers and developers to follow when developing mobile educational apps for children. Regarding the health sector, a set of older people underwent to test three interfaces of a health app to improve the usability of the app in (Alsana et al., 2020). The three interfaces were pictorial, textual, and typing. The result shows that the tasks performed by the typing interface need more extended time than pictorial and textual interfaces.

3. Methodology

An application's registration, food menus, and payment forms are considered the main components of food delivery applications. First, the user starts registering his contact and address information and selecting items from food menus to add to his shopping cart; finally, he fills the payment form to complete the task. In our research, we chose to evaluate these components of selected applications of food and drink category to analyze how far the visually impaired or screen reader users can complete the task of ordering food without difficulty.

3.1Sample of evaluated apps

Although Android is the most widely used mobile platform in Saudi Arabia (Saudi Arabia: Markets Share of Mobile Operating Systems 2018, n,d.), The Voice-over that is the screen reader for apples' devices offers more features than Android's screen reader, which is TalkBack (Serra et al., 2015). For that, our exploration study was conducted on a sample of applications available for Android and iOS to cover requirements for both platforms. Using SensorTower software that analyzes app rankings over time, a set of Top Apps Ranking from the food & drink category in Saudi Arabia were selected for our evaluation. Users can get listings of applications in this tool based on the chosen store and country. We selected Twelve of the top-ranking apps in Saudi Arabia; the selection was based on the following criteria: (a) All are from the food & drink category; (b) Apps have different functionality of the food and drink category (groceries apps or food ordering platforms of different restaurants and shops); (c) All support the Arabic language as it is the native language in Saudi Arabia; (d) All include more items and actions for analyses. The applications were first installed to check which work well and support the Arabic language. Applications that do not match the previous criteria were removed to ensure that various active sets of food delivery applications were included, covering all possible items required to accomplish the task. Table [1] summarizes the selected applications for evaluations, their respective positions in apps and usage ranking of SensorTower category, and purpose of each app.

Table 1: SensorTower's selected applications

Id	Google play Ranking	App store ranking	Application	Category	
1	3	1	Jahez	Food & drink	Food delivery of many stores
2	1	2	HungerStation		
3	6	3	Shgardi		
4	17	8	Talabat		
5	13	6	The Chefz		
6	50	34	Wssel		
1	20	45	BinDawood	Food & drink	Grocery & market
2	8	10	Nana		
3	17	33	Jumlaty		
4	9	37	InstaShop		
5	22	13	Pandaclick		
6	25	50	Speedi		

3.2 Accessibility testing

The application's registration and payment forms and food menus were tested manually using Acc-MobileCheck (Paiva et al., 2020). Acc-MobileCheck is a mobile device app that contains accessibility and usability checklists assessed and validated by a group of experts and mobile apps developers as well as supported by additional information from WCAG. It addresses the problems of Comprehension, Operation, Perception, and Adaptation; these problem types are derived from the WCAG 2.2 principles. A set of questions checks each type. A total of 47 verification items are checked for each application in our study. For each application, the degree of passing in each accessibility guideline among four levels of degrees are recorded. The four levels are: "Yes" fully applicable; "Partially" it meets at least 50% of the questioned usability/accessibility criteria; "No" when it meets less than 50% of the usability/accessibility

criteria examined in the item; "Not Applicable" when it is not possible to assess the usability/accessibility criteria of the item.

In addition to manual testing, testing with Accessibility Scanner, an automatic accessibility validator mobile application analysis tool (Test Your App's Accessibility, n.d.), was used to discover some accessibility criteria that may have been missed in manual testing. (Acosta-Vargas et al., 2019). The tool is normally used to help in assessing the accessibility of mobile applications, and it provides suggestions regarding the app's accessibility.

All the examining and evaluations were conducted using a Samsung S9 running Android version 10 with the TalkBack screen reader and an iPhone 12 with iOS and the Voice-over screen reader.

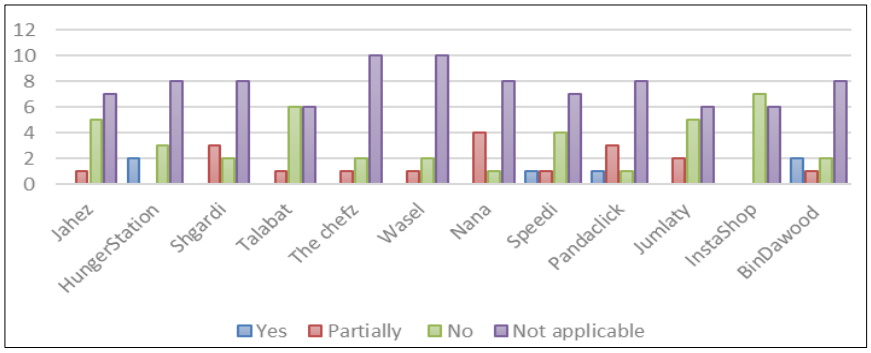
4 Findings

Each app was manually tested using Acc-MobileCheck, where each problem type addressed one of the app's aspects by a set of verification items.

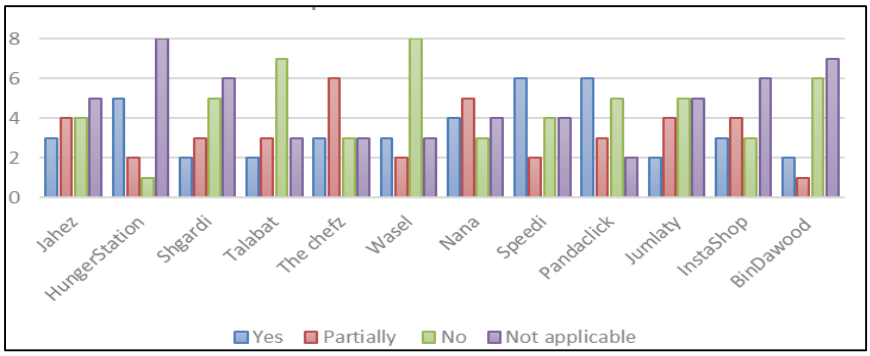
- Comprehension (C): refers to the user's cognitive difficulties in completing tasks while interacting with the app, determined by 16 verification items.
- Operation (O): concerned with the user's inability to complete tasks, determined by 15 verification items.
- Perception (P): concerned with the user's inability to perceive information while doing tasks, determined by 12 verification items.
- Adaptation (A): relates to the user's challenges in dealing with situations, determined by 4 verification items.

Figure 1 (a-c) shows the levels of compliance for the apps by each problem type. Perception and Adaptation problems are the highest in non-compliance in all 12 apps. While in the other two types of problems, the answers vary between the levels. Table [2] shows the most failed items among the four problem types and the rate of failure, where the rate was calculated as follows:

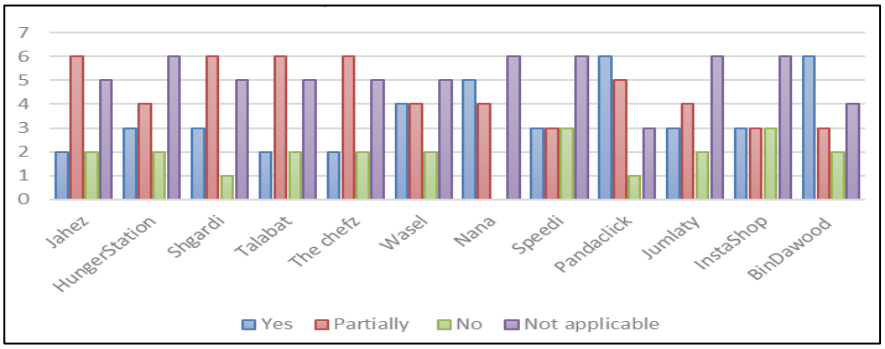
$$\frac{\textit{Number of applications that got a (no) answer}}{\textit{Number of all tested applications}} * 100 + \frac{\textit{Number of applications that got a (Not applicable) answer}}{\textit{Number of all tested applications}} * 100$$



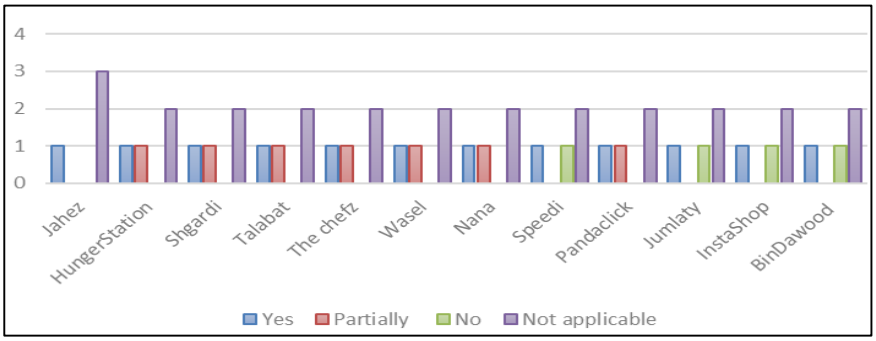
a: Perception Problems



b: Comprehension Problems



c:Operation Problems



d: Adaptation Problems

Figure 1: Levels of compliance for the apps according to problem type

Table 2: Rate of failure for the most failed items

Verification item	Definition	No	Not applicable	Total
C2	Is there a description for all non-text elements that allow reading by AT?	75%	25%	100%
C8	Are the user error messages clear?	41.67%	41.67%	83%
C9	Is a fix alternative provided with the steps and actions necessary for the user to fix the error?	91.67%	0.00%	92%
P5	Does the contrast between the background colors of textual and non-textual elements enable the perception and visualization of these elements?	83.33%	8.33%	92%
P6	Does the font size of textual and non-textual elements enable the perception and visualization of these elements?	75%	8.33%	83%
P7	(Does the application provide accessible alternatives to non-text content elements?	58.33%	41.67%	100%
P9	Is there tactile or audible feedback to the user when a clickable element is selected?	0%	91.67%	92%
A2	Is it possible to change the size and font of the textual elements of the interface?	0%	100%	100%
A3	Does the application support both orientations?	0%	100%	100%
O12	Is it possible for the user to fill in the input fields with voice entries?	0%	100%	100%
O13	Does the clickable area of all clickable elements occupy all and only their extension?	0%	91.67%	92%

Furthermore, the results of the analysis tool also give many comments and suggestions on the accessibility of the app. Figure 2 shows screenshots of Accessibility Scanner suggestions on some food apps. It provides recommendations based on content labels, touch target size, clickable items and text, and image contrast. It scans each page of the app separately. A border identifies the item that lacks accessibility, and the explanation of the issue related to that item and recommendations to enhance it appear by clicking the item. After scanning the 12 apps, we found that all of them got a lot of comments regarding the accessibility of the app. Mostly, all the apps have the problem of color contrast and label naming, which are important to help users with visual impairment complete a task.

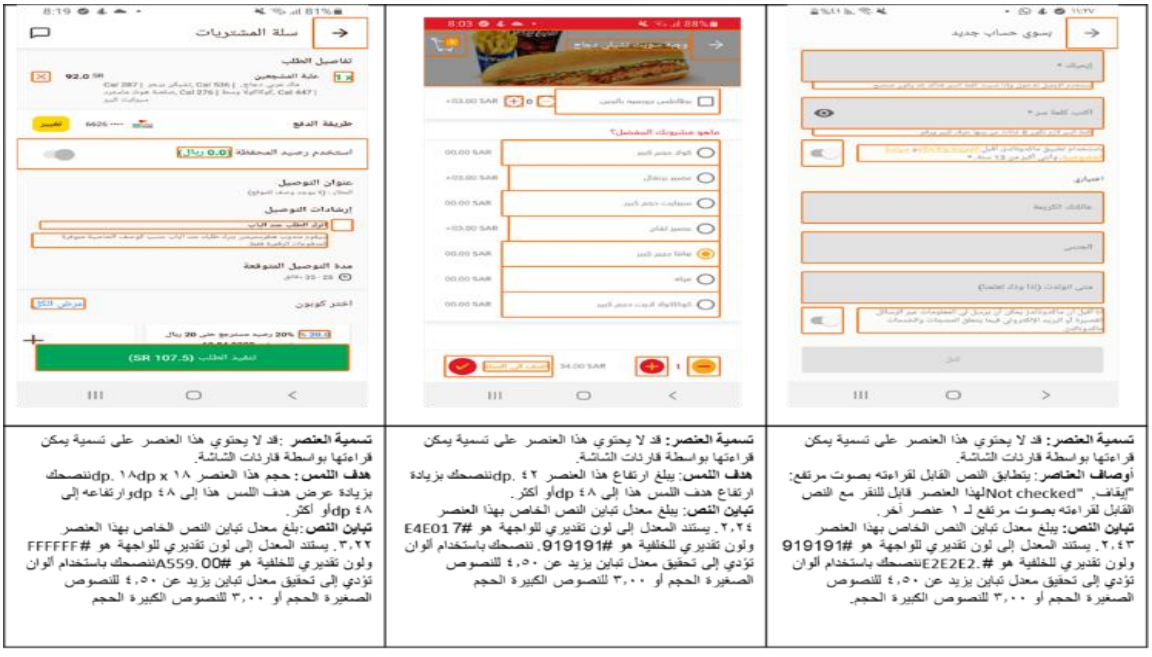


Figure 2: Screenshots of the Accessibility Scanner tool results and the given suggestions

5 Discussion and recommendations

From the previous findings, it was evident that all the evaluated apps don't fulfill the accessibility requirements needed by visually impaired people. The results also show that most registration and payment forms are not built to help easy access and form filling. For example, the Jumlaty app fields don't contain any labels to indicate what the user has to enter. In Jahez, the labels are written as placeholders that appear in gray, which is not visible to people with visual impairment. The error messages used to inform users about their mistakes and help them correct the errors are not applicable in Nana and Instashop; instead of the error message, the field will shake in a way not visible or sensed by visually impaired people.

In Jumlaty and The Chefz, the error messages appear in the English language even if the user chooses the Arabic language for the app. In addition to that, no single app supports voice entries to fill input fields. The same comments apply to payment forms.

Table 3: The most frequently failed items and our recommendation for best practices for visually impaired people

Verification item	Description	Expected difficulties
Non-text content	The graphic items in the app, such as navigation control icons and food images must be defined by alternative text in order for assistive technology users to access them.	The items are not as meaningful for visually impaired and screen reader users; therefore, they won't be able to complete the tasks or know the food they have chosen.
Recommendation: It's important to give users clear descriptions that clarify the meaning and purpose of each interactive element programmatically with proper attributes.		
Text font and size	The font and size of the text must be visible and easy to read by everyone.	Inaccessible font type with decorative and small size has a negative impact on disabled people, particularly those with a visual impairment.
Recommendation: Use a readable font size and type for different types of users, don't use Serif fonts or size less than 14pt.		
Support both orientations	The user should be able to view the same content of the app in both orientations horizontally and vertically.	The user who prefers to use horizontal mode while using the app may face difficulty if he was forced to use the vertical mode only, and vice versa
Recommendation: Design the app to support different screen orientations and the same content needs to be noticeable and visible on both.		

Voice entries	Giving users the ability to fill an input field on a form via voice input.	The screen reader users or visually impaired users may fill the input by their voice. This is easier than typing using the keyboard.
Recommendation: Enable voice recognition features in all input fields in the form as well as search fields. The icon or button indicate to that feature must me visible and near to the field.		
Error messages	Giving accessible error messages that indicate the error, providing solutions or suggestions with any error notifications for fixing the error.	Not giving clear error messages will confuse the user as he doesn't know what the error is and how to fix it.
Recommendation: - Don't rely on color or shake to convey the error message. Give a descriptive message that explains the error in detail and the steps to fix it. Use input masking for phone number and credit card number fields to reduce the possibility of error.		
Color contrast	Giving a good contrast ratio between the background color and the foreground color.	Wrong contrast color may make it difficult to read a text and recognize content by different visual impairments.
Recommendation: Use visual presentation of text and images with contrast ratio of at least 7:1, while 4.5:1 for large-scale text as recommended by WCAG.		
Tactile or audible feedback	If the app has a clickable item, the user will get indicate that audible/tactile feedback that the selection has been made.	If there are any type if feedback the visual impairments will not know if the item is clicked or no.
Recommendation: Give feedback in addition to visual feedback that may not be seen by all. Use noticeable and audible feedback.		
Target size of clickable elements	If the app has a clickable item, touch target size should be large enough to be clicked easily.	Visually impaired users face difficulty interacting with small touch targets on a device's screen.
Recommendation: Touch targets must be at least 48 x 48 dp. Give users the ability to customize the target size according to their needs.		

Furthermore, we found a considerable lack of color contrast, font size issues, and missing alternative texts by looking at restaurants and markets menus. We gathered and represented the most frequently failed items and our recommendation for best practices for visually impaired people in Table [3]. Along with the previous recommendation, we propose to create a tool bar that enables users to choose what they prefer among different color themes and font types and sizes as well as enable them to activate voice recognition and text to speech to fill the forms.

6 Conclusion and limitations

Accessibility of mobile applications with the mentioned numbers of visually impaired people in Saudi Arabia and the increasing number of services provided by mobile apps is becoming an important topic that must be considered. This study evaluates a set of online food delivery applications in both Android and iOS platforms. We found many drawbacks regarding the accessibility of visual impairment appearing in both manual and tool tests. Most of the issues noticed were related to the main tasks needed to accomplish the order, such as the design of registration and payment forms, clickable items, and description of menu content. Although there were various designs used among different apps, the result shows that no single app passed all the verification items given in the checklist. Therefore, mobile applications for online food delivery needs to be enhanced regarding accessibility for the visually impaired. Undoubtedly, this study has limitations. The markup code of the mobile application didn't check to count parsing errors, and the user testing with real visually impaired people was not conducted.

7 Future work

As future work, we intend to perform evaluations on a wider range of delivery applications to examine the accessibility of such services in Saudi Arabia. We also aim to conduct studies with people with visual disabilities to analyze the main problems they face when using mobile applications to help define recommendations for mobile accessibility based on empirical evidence.

References

Acosta-Vargas, P., Zalakeviciute, R., Luján-Mora, S., & Hernandez, W. (2019). Accessibility Evaluation of Mobile Applications for Monitoring Air Quality. In *Advances in Intelligent Systems and Computing* (Vol. 918, Issue February). Springer International Publishing. https://doi.org/10.1007/978-3-030-11890-7_61

Alsana, S., Trapsilawati, F., & Wijayanto, T. (2020). Enabling health application accessibility through interface modalities for elderly. *BIO Web of Conferences*, *28*, 02003. https://doi.org/10.1051/bioconf/20202802003

Badshah, S., Khan, A. A., Hussain, S., & Khan, B. (2020). *What users really think about the usability of smartphone applications : diversity based empirical investigation*.

Bigdeli, O., Afaghzadeh, S., Albadvi, A., & Abdolvand, N. (2009). Barriers of online shopping in developing countries: Case study Iran. *Proceedings of the IADIS International Conference E-Commerce 2009, Part of the IADIS Multi Conference on Computer Science and Information Systems, MCCSIS 2009*, *III*(12), 3–10.

Charski, M. (2015). Web accessibility: Is your content ready for everyone? In *EContent* (Vol. 38, Issue 2, pp. 22–26).

December, E., Author, T., Reserved, A. R., & Doi, P. D. (2014). *Entrepreneurship in Saudi Arabia: An Empirical Investigation of Online Grocery Shopping Behaviour Gurprit Kindra 1 , Sadrudin A. Ahmed 2 & Nidaa Shawli 3*. *1*(2), 1–24. https://doi.org/10.15640/jmise.v1n2a1

Ferati, M., Raufi, B., Kurti, A., & Vogel, B. (2014). Accessibility requirements for blind and visually impaired in a regional context: An exploratory study. *2014 IEEE 2nd International Workshop on Usability and Accessibility Focused Requirements Engineering, UsARE 2014 - Proceedings*, 13–16. https://doi.org/10.1109/UsARE.2014.6890995

General Authority for Statistics. (2017). *Disability Survey*. https://www.stats.gov.sa/sites/default/files/disability_survey_2017_en.pdf

Griffin-Shirley, N., Banda, D. R., Ajuwon, P. M., Cheon, J., Lee, J., Park, H. R., & Lyngdoh, S. N. (2017). A survey on the use of mobile applications for people who are visually impaired. *Journal of Visual Impairment and Blindness*, *111*(4), 307–323. https://doi.org/10.1177/0145482x1711100402

In Saudi Arabia; Revenue of Orders Made Through Delivery Applications Reaches Over 2 Billion Riyals. (n.d.). Retrieved July 21, 2022, from https://www.citc.gov.sa/en/mediacenter/pressreleases/Pages/20200728.aspx

Khan, M. F. (2020). A UNIFIED FACTOR ANALYSIS AND DISTANCE BASED EVALUATION APPROACH TO EVALUATE THE PREFERENCES TOWARDS ONLINE FOOD ORDERING APPLICATIONS IN SAUDI ARABIA. *INTERNATIONAL JOURNAL OF MANAGEMENT*, *11*(12), 1752–1762. https://doi.org/10.34218/ijm.11.12.2020.161

Korn, P., Normand, L. M., Pluke, M., Snow-Weaver, A., & Vanderheiden, G. (2013). *Applying WCAG 2.0 to Non-Web Information and Communications Technologies*. https://www.w3.org/TR/wcag2ict/

Masood, M., & Thigambaram, M. (2015). The Usability of Mobile Applications for Pre-schoolers. *Procedia - Social and Behavioral Sciences*, *197*(February), 1818–1826. https://doi.org/10.1016/j.sbspro.2015.07.241

Mi, N., Cavuoto, L. A., Benson, K., Smith-Jackson, T., & Nussbaum, M. A. (2014). A heuristic checklist for an accessible smartphone interface design. *Universal Access in the Information Society*, *13*(4), 351–365. https://doi.org/10.1007/s10209-013-0321-4

Newswire, P. (2021). *Saudi Arabia $500+ Million Online Food Ordering and Delivery Market to 2026: Digitization and Emergence of Advanced Online Services is Expected to Drive Growth*. Research and Markets. https://doi.org/Research and Markets

Paiva, D. M. B., Batista, M. H. da S., Zaina, L. A. M., & Fortes, R. P. de M. (2020). Acc-MobileCheck: a Checklist for Usability and Accessibility Evaluation of Mobile Applications. *CLEI Electronic Journal*, *23*(2). https://doi.org/10.19153/cleiej.23.2.3

Patch, K., Systems, R., Wahlbin, K., & Accessibility, I. (2021). *Mobile Accessibility : How WCAG 2 . 0 and Other W3C / WAI Guidelines Apply to Mobile*. 1–14.

Saudi Arabia: markets share of mobile operating systems 2018. (2018). Statista. https://www.statista.com/statistics/935965/saudi-arabia-markets-share-mobile-operating-systems/

Serra, L. C., Carvalho, L. P., Ferreira, L. P., Vaz, J. B. S., & Freire, A. P. (2015). Accessibility Evaluation of E-Government Mobile Applications in Brazil. *Procedia Computer Science*, *67*(Dsai), 348–357. https://doi.org/10.1016/j.procs.2015.09.279

Statista. (n.d.). • *Smartphone users in Saudi Arabia 2018-2023 | Statista*. Retrieved November 13, 2021, from https://www.statista.com/statistics/494616/smartphone-users-in-saudi-arabia/

Sultan, N., Siddiq, K., Rashid, T., & Farooque, M. (2015). Evaluation of Smart Phone Applications Accessibility for Blind Users. *International Journal of Computer Applications*, *127*(3), 9–16. https://doi.org/10.5120/ijca2015906343

Test your app's accessibility | Android Developers. (n.d.). Retrieved July 20, 2022, from https://developer.android.com/guide/topics/ui/accessibility/testing#accessibility-scanner

Vendome, C., Solano, D., & Linares-vásquez, M. (n.d.). *Can everyone use my app ? An Empirical Study on Accessibility in Android Apps*.

Vishnu Prasad, S., Kumar, M., Ramakrishnan, M., & Ravikumar, D. (2018). Report on oral health status and treatment needs of 5–15 years old children with sensory deficits in Chennai, India. In *Special Care in Dentistry* (Vol. 38, Issue 1, pp. 58–59). https://doi.org/10.1111/scd.12267

Walker, B. N., Tomlinson, B. J., & Schuett, J. H. (2017). Universal design of mobile apps: Making weather information accessible. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *10277 LNCS*, 113–122. https://doi.org/10.1007/978-3-319-58706-6_9

Web Content Accessibility Guidelines (WCAG) Overview | Web Accessibility Initiative (WAI) | W3C. (n.d.). Retrieved November 25, 2021, from https://www.w3.org/WAI/standards-guidelines/wcag/